NRC FORM 195 (2-76)

U.S. NUCLEAR REGULATORY COMMISSION

DOCKET NUMBER 50-410

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TO: D. B. Vassallo

FROM: Niagara Mohawk Power Corp. Syracuse, New York R. R. Schneider

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(1-P)

PLANT NAME: Nine Mile Point #2

ENCLOSURE

Furnishing requested information regarding the revetment ditch system for Unit No. 2.

(17-P) ACKNOWLEDGED

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FOR ACTION/INFORMATION

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NIAGARA MOHAWK POWER CORPORATION

NIAGARA MOHAWK

300 ERIE BOULEVARD WEST
SYRACUSE, N.Y. 13202

September 9, 1976

Director of Nuclear Reactor Regulation
Attn: Mr. D. B. Vassallo, Chief
Light Water Reactors
Branch #4
Division of Project Management
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Re: Nine Mile Point Unit 2
Docket No. 50-410

Dear Mr. Vassallo:

Enclosed is information requested in your July 16, 1976 letter regarding the revetment ditch system for Nine Mile Point Unit 2. Five copies of this information are provided which responds to your questions 1, 2, 4, 5 and 6. Information responding to questions 3 and 7 will be submitted about September 28, 1976.

Very truly yours,

NIAGARA MOHAWK POWER CORPORATION

R. R. SCHNEIDER
Vice President-Electric Production

9409

Enclosure

Request 1

We have evaluated Chapter 2, Storm Surge Model of the February, 1976, report and compared it to the 1973 response to question 34 of our CP review and have identified three items that have been changed or added: 1) the 1976 report contains more verification data, 2) the 1976 report uses a different historical storm as the basis of the Probable Maximum Storm and 3) the 1976 report contains an analysis of the surge resulting from the Probable Maximum Squall Line. Have there been any other changes that are incorporated into the 1976 analysis? In particular, has the surge model been changed during the three year interval between reports? Identify all changes in the models and the analysis and substantiate that they are conservative.

Response 1

With the exception of the three items identified above, no other changes in the storm surge model have been made.

Item 1:

In the February, 1976,[1] report, five more verifications of the storm surge model were included, namely February, 1956, and February, 1972, storms for Lake Ontario, and February, 1956, January, 1972, and February, 1972, storms for Lake Erie. In the 1973 response to Request 2.34 of the Nuclear Regulatory Commission's construction permit review, the January, 1972, storm for Lake Ontario was used for verification. For all the verifications, the storm surge model was the same, with no changes being made between the first and later verifications.

Item 2:

The historical storm upon which the probable maximum windstorm (PMWS) was based was changed because a more descriptive windstorm model than originally presented in PSAR Response 2.34 [2] was desired. It was also decided to use a more severe historical storm as the basis for the model. The January 30, 1971, storm was selected as the base storm; it had the second lowest central pressure (972 mb) of the 12 storms causing high surges on Lake Erie and Lake Ontario between 1955, and 1973. The only storm with a lower pressure occurred on February 25, 1956 (964 mb), but the facsimile maps necessary for model development were of poor quality. The lowest central pressure of the January 25, 1972, storm (which was used in the original analysis) was 976 mb. In addition, the 1971 storm was more compact than the 1972 storm, and had a tighter pressure gradient throughout its influence on the lake.

The implication of these changes is that use of a more intense storm to develop a more complex windstorm model will more closely approximate a PMWS.

Item 3:

The consideration of a squall line case is a conservative approach to the surge analysis. The squall line case was examined as a second potentially important type of surge generating mechanism. Results of this study indicate that the squall-line-induced surge is smaller than the surge due to a PMWS. Various squall line models were developed and tested in the storm surge model. Section 2.3 of the 1976 report (1) discusses various squall line models and the resultant surge.

Request 2

The verification studies are inconclusive in defining the accuracy to which the model can predict storm surge. In addition to fluctuations in the predicted surge hydrographs, that in many cases are very different from that recorded, extreme values are seen to differ by tens of percent in several cases. In particular, the model underpredicts the surge at Oswego (the only verification gage station near the site) from the February, 1972, storm by over 15 percent. It is our position that either the model be revised to conservatively reproduce historical storm surges or criteria be developed to increase predicted extreme surge values to produce conservative results.

In addition, for verification studies include maps locating gage stations and grid points and depths where the surge was calculated.

Response 2

Verification studies of the storm surge model were conducted using historical meteorological data as discussed in Section 2.1.2 of the 1976 report (1). Weather data from eight stations around Lake Ontario and five stations around Lake Erie were analyzed and averaged to represent conditions in three zones of each lake. This analysis technique involved the meteorological judgment and subjectivity common to all synoptic analyses. Windspeeds over the water were estimated from overland speeds using a simple ratio technique presented in the literature. (3) This method also is not exact. Zonal average wind and pressure conditions were then used as input to the surge model. The simulated surges show both over- and under-predictions as compared to actual recorded data at different gage stations. It should be pointed out that the model conservatively reproduced the surges most of the time at most of the gage stations, and the under-prediction at the Oswego gage station for February, 1972, was only 1.0 inches. The simulated surges follow the recorded hydrographs closely and are considered satisfactory in view of the state-of-the-art in storm surge numerical modeling. Considering the paucity of meteorological stations with data and the subjectivity and averaging inherent in the meteorological analysis, the verifications indicate that the model can adequately reproduce the historical surge events.

For the probable maximum windstorm (PMWS) surge prediction, a model of a PMWS is first conservatively constructed. The wind velocity over the lake is then generated by moving the PMWS along the specified track. Since the wind velocity is taken directly from the PMWS model, no meteorological judgment or data problems are involved in the wind velocity derivation. Hence the PMWS surge results should directly reflect the PMWS wind affect and is completely free from uncertainty in the derivation of historical wind field. Since the PMWS model is conservatively constructed, the PMWS surge is conservatively generated by a verified model.

The probable maximum wind blowing toward the east in the direction approximately along the major axis of the lake will result in setdown and setup on the west and east ends of the lake, respectively. The water surface profile will be very similar to Figure R-2.34-13(2) and Figure 2.1-12(1). The equal surge lines are nearly perpendicular to the shore line near the site and there is no significant difference between surges at deep and shallow waters along a transect perpendicular to the shoreline through the site. Under this condition, no extrapolation of surge from the grid point to the site is necessary.

Figures 1 and 2 show the computation grid, water depths and actual verification gage locations for Lakes Ontario and Erie, respectively. In the verification studies, the grid points nearest to the actual gage stations were selected and the calculated surges at these points were compared to the recorded surges at the gage stations. Tables 1 and 2 list gage stations, verification grid points, and water depths at each grid point for Lake Ontario and Lake Erie.

The model of the Probable Maximum Wind Storm used in the 1976 report is different from that used previously. How does the resulting storm surge at the site differ from that previously computed? Figures showing the predicted surge and a map with the computational grid, showing the location of the point where the surge was calculated, should be provided. The water depth used in the computations for the surge at the site should be stated (figure R2.34-4 is not clear in this regard).

Response 4

The probable maximum wind storm (PMWS) surge of 2.35 ft based on a PMWS model developed using the January, 1972, storm was reported to NRC in the 1973 response to Request 2.34.(2) The surge hydrograph was presented in Figure R-2.34-12. Response 1 of this submission discusses the changes in the PMWS model. Section 2.2 of the 1976 report (1) describes the current PMWS model and its conservatism. The surge hydrographs for the new PMWS model for the cases in Table 2.2-4 of the 1976 report are shown in Figures 3 through 7.

By comparing Figures 3, 4, and 7 to Figure R-2.34-12, it can be seen that the new PMWS model generates surge with steeper rise, higher peak, and longer duration of high surge. The results indicate that the new PMWS model is more conservative than the old model. Figures 5 and 6 show the surges at the plant site for a 13 mph slow moving wind storm. The surges have a slower rise and longer duration of high surge reflecting the slow moving nature of the storm. In spite of some differences in shape among the sensitivity test cases, the variation of peak surges is very small as presented in Table 2.2-4 of the 1976 report.

The grid point selected for the plant site is (47,8). The average water depth is computed by averaging the water in the grids surrounding the grid point. This is the most representative model grid location of the site with an average water depth of about 93 feet as shown in Figure 1.

Request 5

The applicant states that the storm track used for the PMWS surge estimate produced the most conservative results; other tracks produced smaller surges. Provide a map showing the other tracks tested and a table listing the surge elevations produced.

Response 5

The sensitivity analysis for storm track was investigated during a probable maximum wind storm (PMWS) based on the January, 1972, wind field. The PMWS was generated by increasing the entire wind field of the January, 1972, storm by a ratio of 100/52 to achieve a maximum wind speed of 100 mph [(2)]. Since it was not a synthetic model like the one shown in the 1976 report [(1)], wind fields in the old PMWS model cannot be generated by moving the storm along a specific track.

Instead of testing the sensitivity of the surge with respect to storm track, the sensitivity of the surge at the site was tested by changing the wind direction in Zone 3 (Figure 1) of the PMWS in the 1973 response [(2)] to be approximately perpendicular to the general shoreline slightly prior to the peak surge. The purpose of this manipulation of the wind field is to have the wind initially blowing along the lake axis to generate set up on the east end of the lake and then suddenly change the wind direction to blow toward the southeast shore near the time of the peak surge, so that the east end of the lake will be further tilted upward near the site. This situation can not possibly occur; however, it would represent the worst possible case to be tested. A computer run was performed having all wind in Zone 3 shifted to blow 315 degrees from north beginning at 28 hours after incidence of the PMWS (refer to Figure R-2.34-12 [(2)] for timing). The resulting peak surge was 2.26 ft which is slightly smaller than the peak surge of 2.35 ft (Figure R-2.34-12) without the wind direction change.

From the computer run mentioned above, it was observed that the surge at the site did not increase in response to an onshore wind near the time of the peak surge. Therefore, it is concluded that the PMWS wind blowing approximately along the lake axis would generate the highest surge. Other storm tracks with shorter fetch and wind direction not along the major lake axis would result in smaller surges at the plant site. Since the wind blowing along the lake axis will also generate the maximum wave, the storm track shown in the 1976 report [(1)] is believed to be the most critical track for the site. No surge sensitivity analysis of storm track was performed using the PMWS model presented in the 1976 report but the same conclusion would be reached.

Request 6

How was the storm translation speed added to the wind speeds and how does the resultant wind vary over the lake? Table 2.2-3 does not include the effects of storm translation speed as discussed with you in May, 1973.

Response 6

As discussed with the Commission Staff and its consultant on September 26, 1973, and presented in Section 2.2.2 of the 1976 report a translation speed approximating that of the historical storm was used for the probable maximum windstorm (PMWS). Table 2.2-3 presents resultant windspeeds, which include the 40 mph translation speed. It was pointed out to the Staff's consultant in a November, 1973, telephone conversation that breaking the storm into translational and rotational components, and varying one or both, might change the pressure and wind patterns sufficiently to render the model meteorologically inconsistent. (1)

Table 2.2-4 of the 1976 report presents the results of surge calculations run for various maximum windspeeds and translation speeds. Included is a case with a 13 mph translation speed, which was derived by slowing the 40 mph translation speed by a factor of three and consequently increasing the duration of the storm at the site. It is evident that there is little effect due to these modifications. If the rotational component were also changed, the wind would blow from less conservative directions (i.e., not along the major axis of the lake), and the surges would be lower. Thus, it appears to be unnecessary to synthesize a wind field which could produce less conservative surge values.

References

1. Preliminary Safety Analysis Report, Nine Mile Point Nuclear Station - Unit 2, Niagara Mohawk Power Corporation, Response 2.34, Supplement 10.

2. Design and Analysis Methods for Revetment-Ditch System, Nine Mile Point Nuclear Station - Unit 2, Docket No. 50-410, Niagara Mohawk Power Corporation, February, 1976.

3. Winds on the Great Lakes, F. Lemire, Meteorological Branch, Department of Transportation, CIR-3560, TEC-380, 1971.

Table 1

Lake Ontario Gage Stations and Verification Grid Points

Gage Station	Location* (Latitude) (Longitude)	Nearest Grid Point (x,y)	Water Depth at Grid Point (ft)
Toronto	43° 38' 23" 79° 22' 50"	7,9	101
Kingston	44° 07' 03" 76° 31' 03"	45,19	26
Cape Vincent	44° 07' 45" 76° 20' 15"	47,17	34
Oswego	43° 27' 51" 76° 30' 42"	46,7	93
Rochester	43° 16' 10" 77° 37' 30"	31,3	94
Port Weller	43° 14' 12" 79° 13' 12"	11,3	23

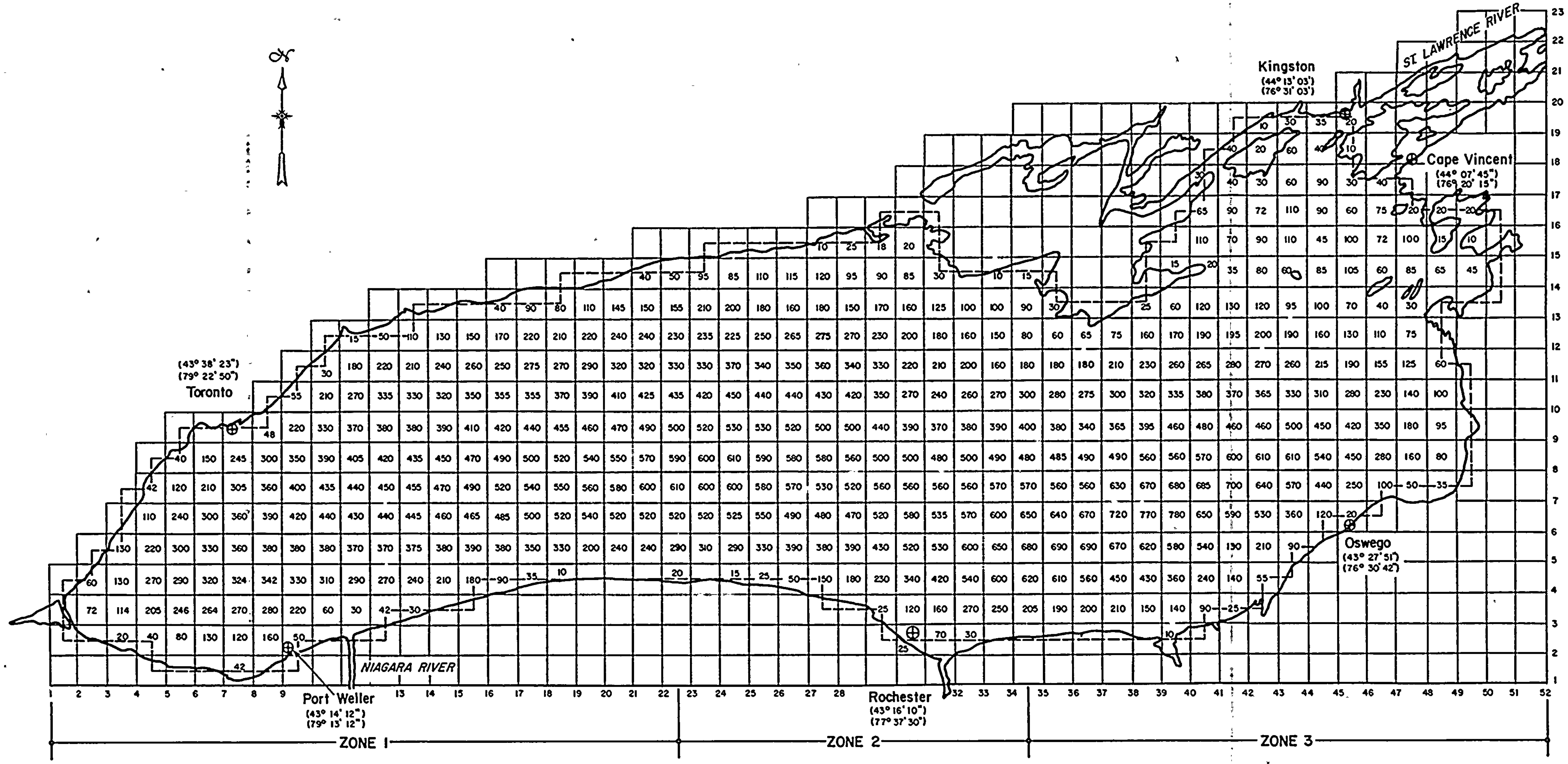
*Locations from R. Goodnough, National Oceanic and Atmospheric Administration, Rockville, Maryland.

Table 2

Lake Erie Gage Stations and Verification Grid Points

Gage Station	Location* (Latitude) (Longitude)	Nearest Grid Point (x,y)	Water Depth at Grid Point (ft)
Port Stanley	42° 39' 32" 81° 12' 48"	36,18	21
Port Colborne	42° 52' 26" 79° 15' 12"	62,12	35
Buffalo	42° 52' 39" 78° 53' 27"	66,11	16
Sturgeon Point	42° 41' 27" 79° 02' 52"	63,9	43
Cleveland	41° 32' 27" 81° 38' 08"	22,2	27
Fermi Plant	41° 57' 35" 83° 15' 30"	18,8	6

*Locations from R. Goodnough, National Oceanic and Atmospheric Administration, Rockville, Maryland.



KEY

LAKE BOUNDARY

COMPUTATION GRID BOUNDARY

Toronto (43° 38' 23") (79° 22' 50") — LATITUDE, LONGITUDE

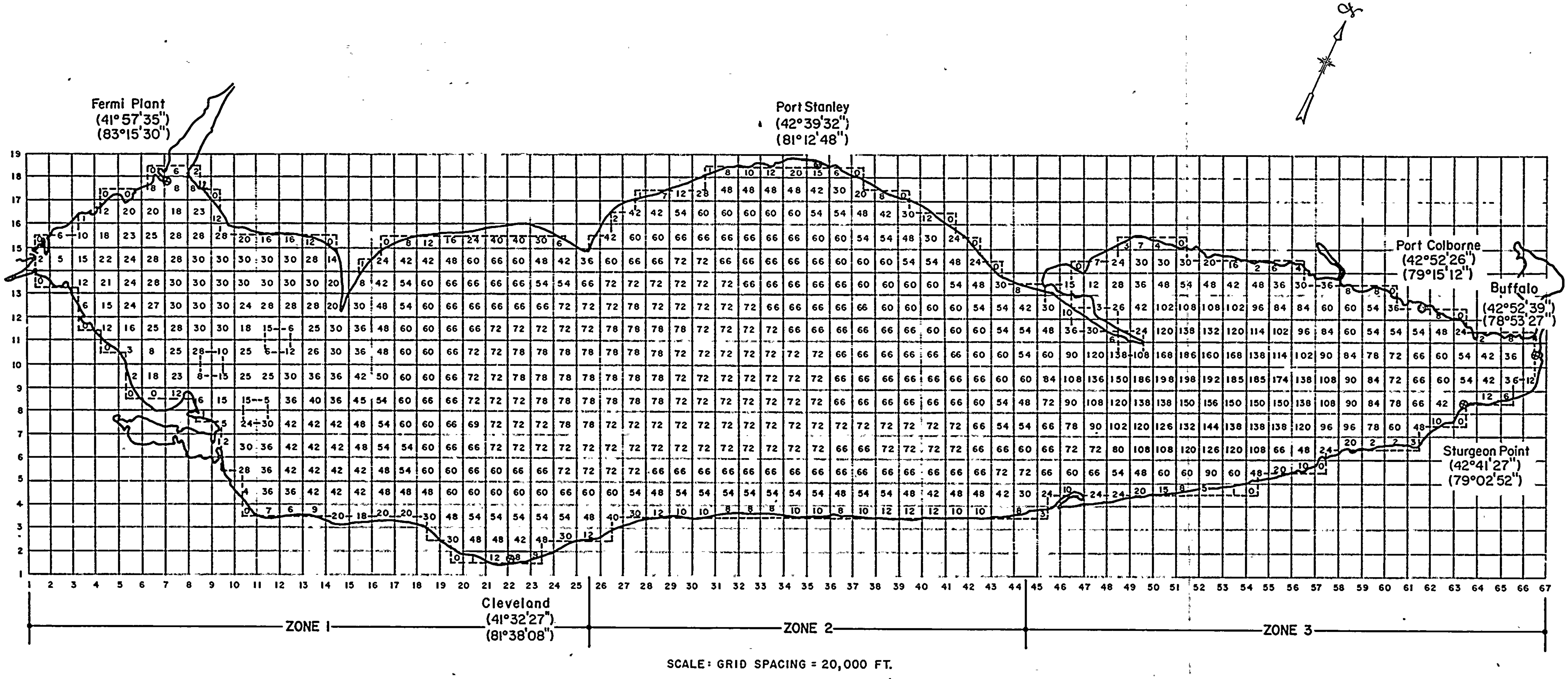
⊕ GAGE STATION LOCATION

450 — WATER DEPTH IN FEET BASED ON LOW WATER DATUM 242.8 FT. INTERNATIONAL GREAT LAKES DATUM.

SCALE: GRID SPACING = 20,000 FT.

FIGURE 1
LAKE ONTARIO COMPUTATION GRID AND BOTTOM DEPTHS

NINE MILE POINT NUCLEAR STATION- UNIT 2
NIAGARA MOHAWK POWER CORPORATION



KEY

LAKE BOUNDARY

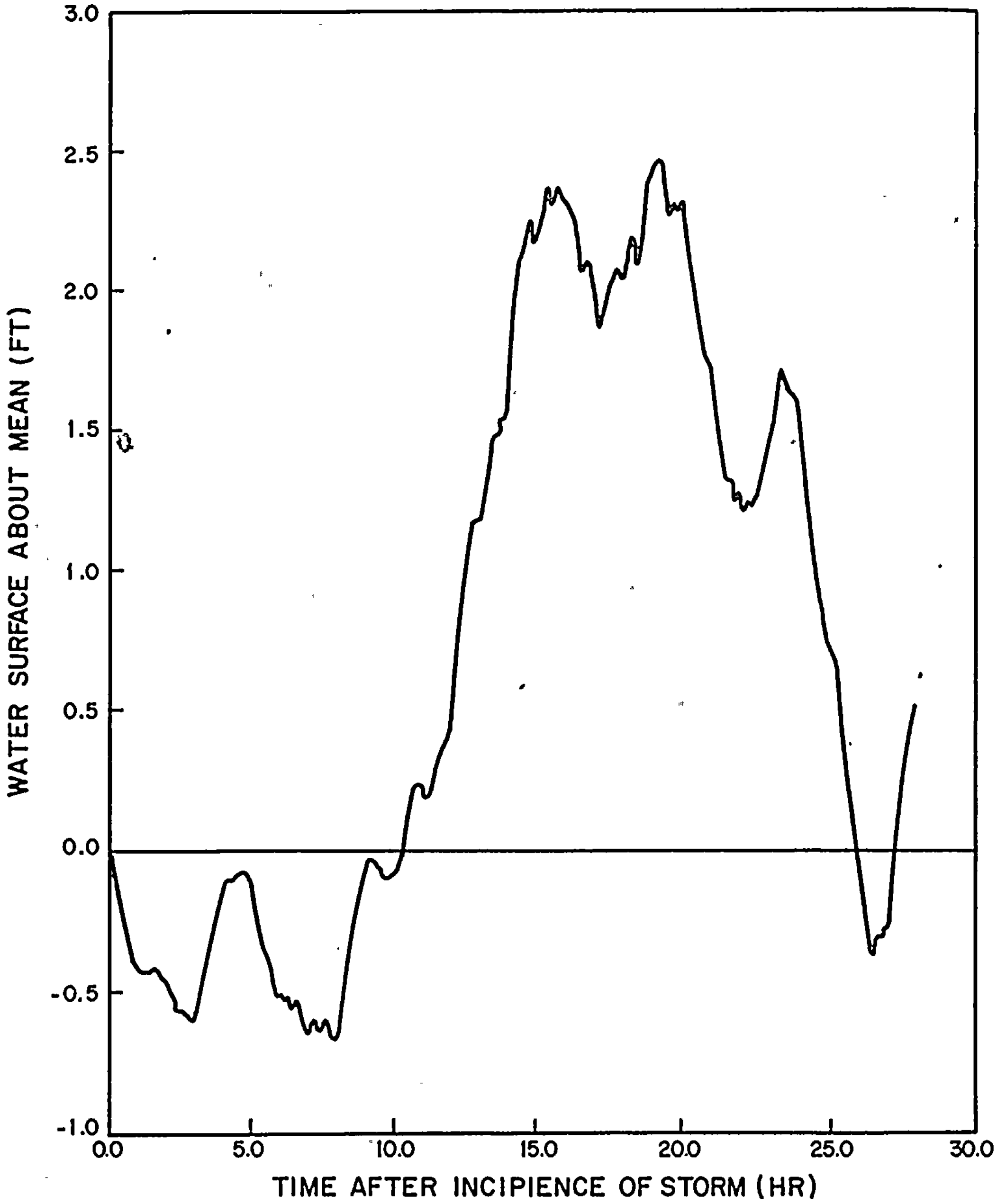
COMPUTATION GRID BOUNDARY

Cleveland (41°32'27") (81°38'08") — LATITUDE LONGITUDE

⊕ GAGE STATION LOCATION

90 — WATER DEPTH IN FEET BASED ON LOW WATER DATUM 568.6 FT. INTERNATIONAL GREAT LAKES DATUM.

FIGURE 2
LAKE ERIE COMPUTATION GRID AND BOTTOM DEPTHS
NINE MILE POINT NUCLEAR PLANT-UNIT 2
NIAGARA MOHAWK POWER CORPORATION



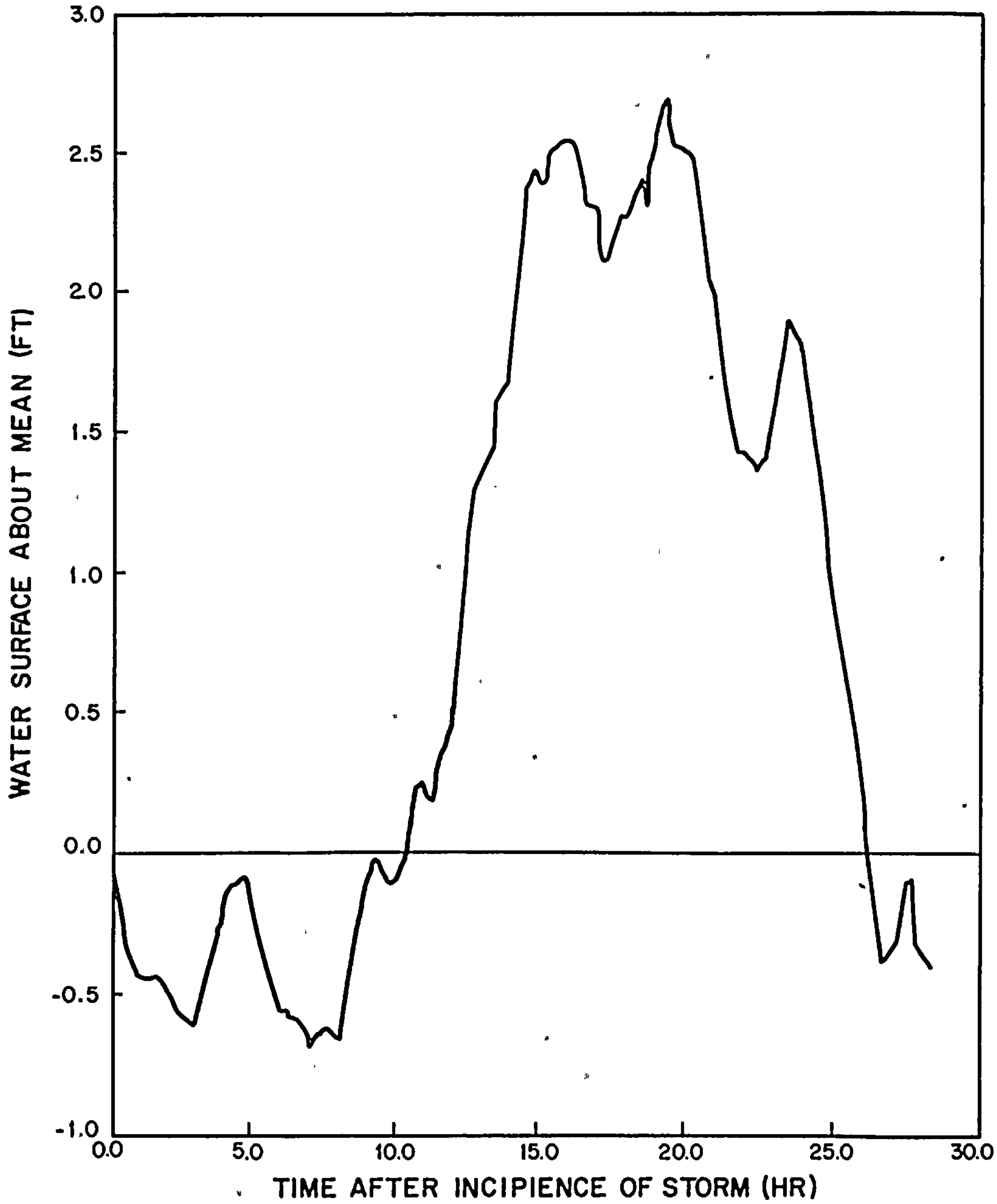
CASE 1 CONDITIONS

STORM FORWARD SPEED = 40 M.P.H.
MAXIMUM WIND SPEED = 100 M.P.H.
WIND SHEAR STRESS = 1.1K

FIGURE 3

PREDICTED PROBABLE MAXIMUM STORM SURGE AT PLANT SITE - CASE 1

NINE MILE POINT NUCLEAR STATION - UNIT 2
NIAGARA MOHAWK POWER CORPORATION



CASE 2 CONDITIONS

STORM FORWARD SPEED = 40 M.P.H.
MAXIMUM WIND SPEED = 100 M.P.H.
WIND SHEAR STRESS = 1.1 K

FIGURE 4

PREDICTED PROBABLE MAXIMUM STORM SURGE AT PLANT SITE-CASE 2

NINE MILE POINT NUCLEAR STATION-UNIT 2
NIAGARA MOHAWK POWER CORPORATION

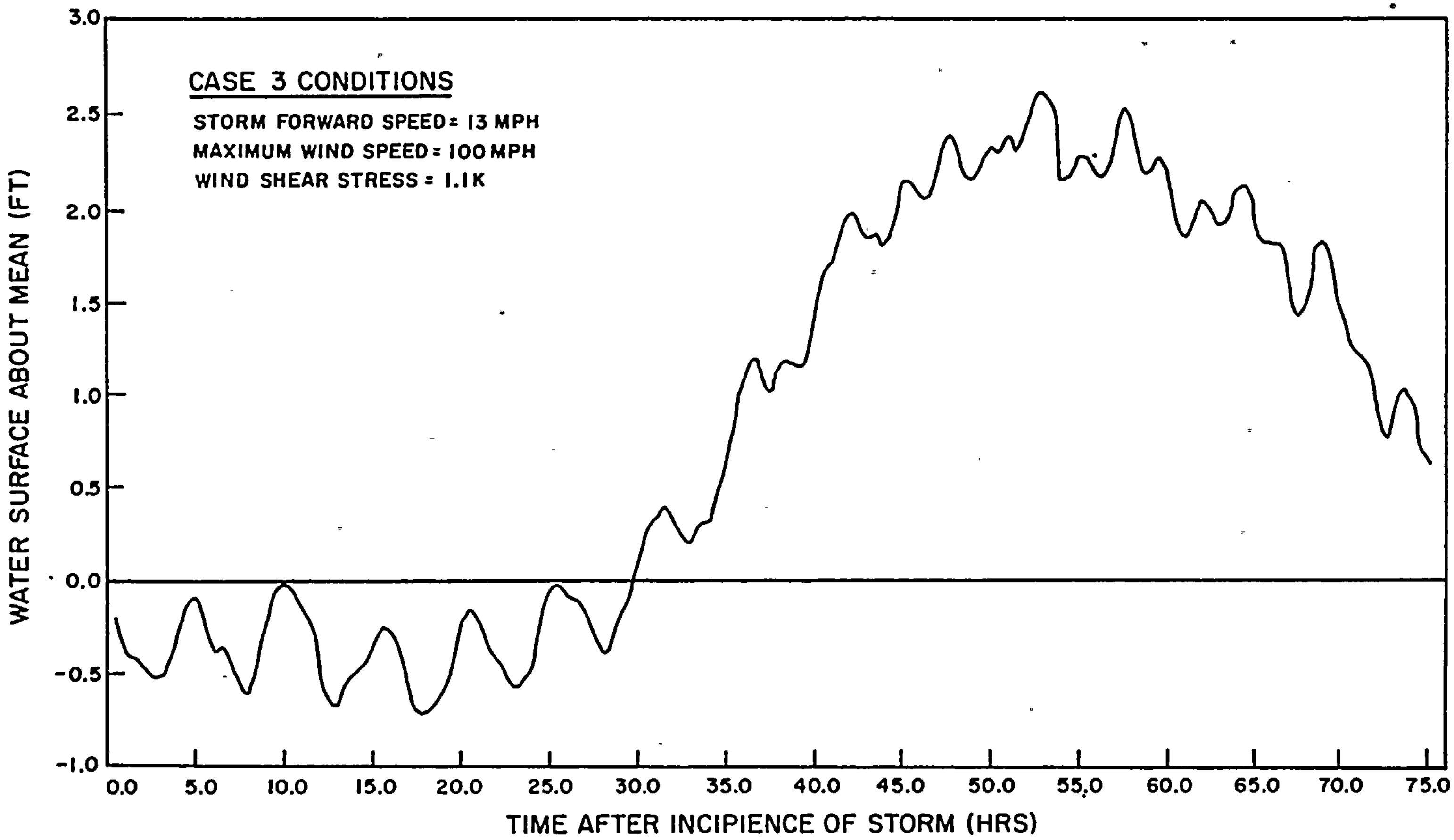


FIGURE 5

PREDICTED PROBABLE MAXIMUM STORM SURGE AT PLANT SITE — CASE 3

NINE MILE POINT NUCLEAR STATION - UNIT 2
NIAGARA MOHAWK POWER CORPORATION

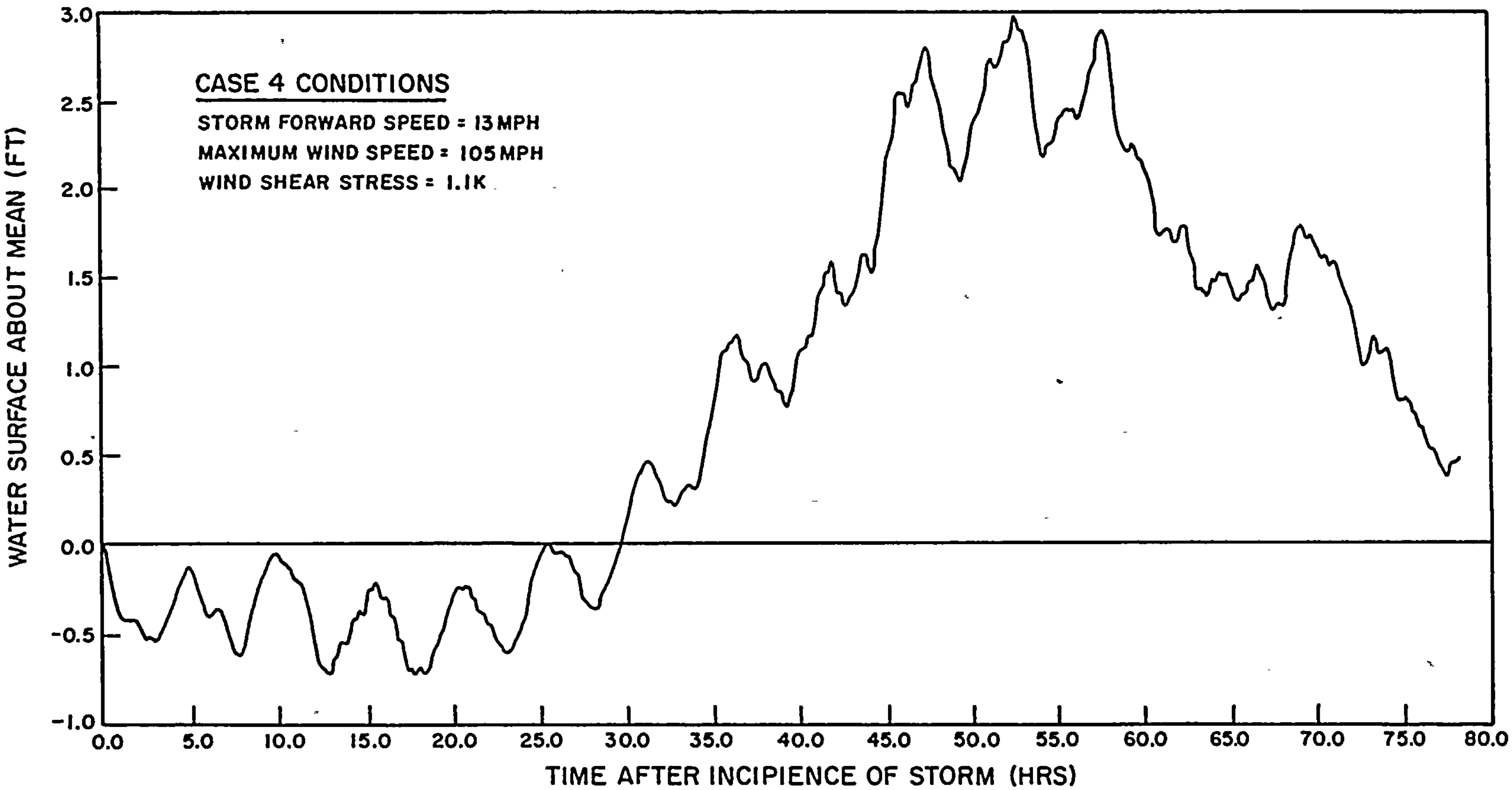
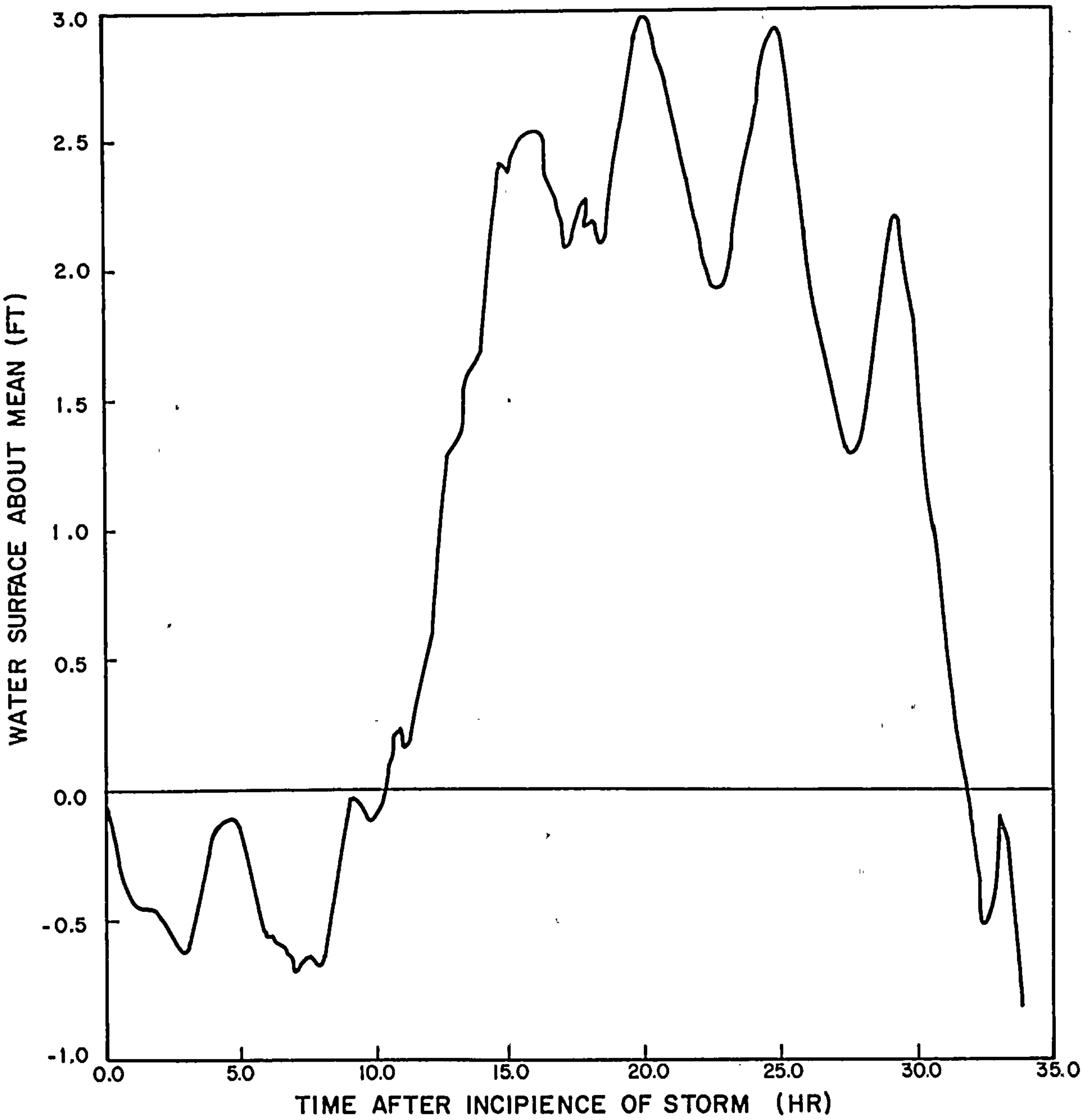


FIGURE 6

PREDICTED PROBABLE MAXIMUM STORM SURGE AT PLANT SITE – CASE 4

NINE MILE POINT NUCLEAR STATION - UNIT 2

NIAGARA MOHAWK POWER CORPORATION



CASE 5 CONDITIONS

STORM FORWARD SPEED = 40 M.P.H. THEN O M.P.H. FOR 8 HRS.

MAXIMUM WIND SPEED = 100 M.P.H.

WIND SHEAR STRESS = 1.1K

FIGURE 7

PREDICTED PROBABLE MAXIMUM STORM SURGE AT PLANT SITE-CASE 5

NINE MILE POINT NUCLEAR STATION-UNIT 2

NIAGARA MOWHAWK POWER CORPORATION